

J Robb
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CRUISE REPORT

R/V ADVANCE II 75-4
and Nekton Beta

17-21 August 1975

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CRUISE REPORT

Vessels: R/V ADVANCE II; Master: Jordan

DSRV NEKTON BETA; Pilots: Slater, Zahoran, O'Donnell

Cruise Number: ADVANCE II 75-4

Area: Middle Continental Shelf (Baltimore Trough) - Philadelphia

Sewage and Dupont Acid Dumpsites

Ports: Cape May to Cape May

Date: 17-21 August 1975

Personnel:

EPA: Pesch, J.

Lear, D.

Meyer, R.

Payne, R.

Johnson, R.

Johnson, M.

Muir, W.

Davis, R.

Dintenfass, A.

Ramsey, B.

Thomas, W.

Meyer, R.

Co-Chief Scientist

Co-Chief Scientist

University of Delaware:

Davis, G.

Philpott, W.

Coast Guard:

O'Neill

Eastman

U.S. Geological Survey:

Folger, D.

Edward, D.

Morse, L.

Purdy, S.

Cousins, P.

Rindge, S.

Navigation and Scientific Equipment:

Loran A

ORE side scan sonar

Benthos bottom camera

Niskin bottles

Filtration apparatus

Smith-McIntyre grab samples

Shipek grab sampler

Bathythermographs

Oxygen meter

Salinometer

Rocking chair dredge

35mm cameras (hand held)

Television

Plankton nets

Nephelometer

Surficial sediment sampler

Current meter

Current drogues

Radiometer

Purpose:

The main objectives of the cruise were to assess biologic, geologic, hydrologic characteristics of the Philadelphia sewage and Dupont acid dump sites. Bottom sediments and organisms were to be selectively sampled with respect to microtopography. The surficial flocky layer was to be sampled if possible. Bottom current direction and velocity were to be measured, and the temperature, salinity, and oxygen distribution of the water column assessed. These data were to assist in evaluating the effects on the wastes on water column and bottom. The U.S. Geological Survey objectives were to assist in the assessment of waste impact on geologic phenomena and to evaluate the character of the bottom with respect to microtopography, sediment texture and mobility.

Data Acquired by the U.S. Geological Survey:

A U.S.G.S. observer aboard the submarine for one dive at each of 5 EPA stations acquired TV, 35mm color and black and white photography, and sediment samples. From the ADVANCE II, the following data were collected: bottom photos at 3 stations, 10 BT lowerings, 5 nephelometer lowerings, 25 sediment samples, 12 suspended matter samples, and 30 km of side scan sonar data.

Preliminary Results:

Water Column - The top of the thermocline (26-27°C) was between 8 and 12 meters deep. Bottom water temperature was about 8°C. Turbidity (mostly plankton) was greatest above the thermocline. Visibility was as much as 15 meters on the bottom.

Bottom current flow was estimated at as little as 1 centimeter per second to as much as 10 centimeters per second. The direction of flow was variable.

Bottom - Microtopography on the bottom ranged from areas with scattered small hummocks and pits to areas with well developed symmetrical ripples. The trend of ripple crests was most often $210^{\circ}T$ with wave lengths of 30 cm and wave heights of 4-5 cm. The small features graded into some ridge and swale microtopography with wavelengths of several meters and wave heights of 60 cm. None of the ripples appeared to be active.

The surficial sediment layer was commonly a flocky or fluffy material that was resuspended when stirred up with the manipulator arm. This layer was most often gray-brown to dark brown in color but in the area of the acid dump site it had a reddish-brown tinge. It was thin to absent on ripple and mound crest and thickest (up to 3mm) in troughs and depressions.

Much of the bottom was covered with shells and shell fragments, of sea clams, quahogs, razor clams, and sand dollars. In some areas many shells were articulated suggesting that they had not died a long time previously. Dominant live organisms included hake, scallops, crabs, shrimp, starfish and sand dollars.

In summary, there was little difference in water column or bottom between the sites located in the dumpsites and the site located about 25 km to the northwest. The flocky layer may have been somewhat thicker in the Philadelphia dumpsite but there were patches of it that seemed to be equally thick in the control site.

The reddish layer in the acid dumpsite seemed to be also present at the control site. Bottom microtopography was somewhat higher suggesting that perhaps storms over the winter or the hurricane that passed the area in July 1975 had created a new larger pattern of ripple marks. Most probably, the waste material released at the dumpsite areas is

widely distributed above the thermocline by the predominate surface currents. Evidence for concentrated accumulation on the bottom is lacking. The bottom material apparently is moved only at times when large storms create waves sufficiently large to touch bottom. Thus, surficial sand mobility will coincide with times of maximum waves and winds at the surface.

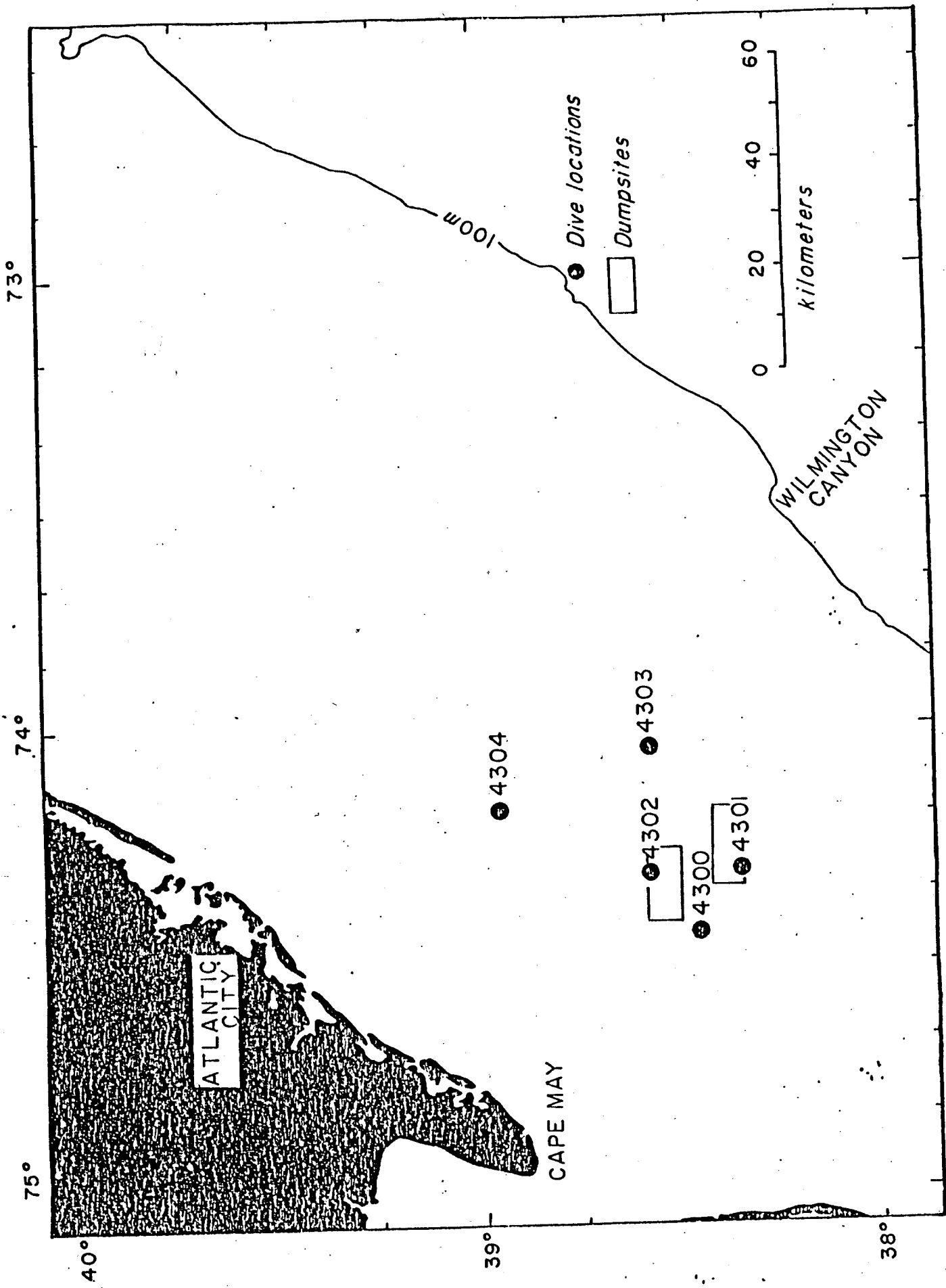


FIGURE 1. DIVE LOCATIONS

This is 17 August 1975, commencing dive #437 on Nekton Beta at 1532.- EPA station 22. Temperature at the surface 19° C. Visibility - very poor. High turbidity, much plankton. We are now passing through approximately 70 feet - temperature 11° centigrade. Now passing through 110 feet - temperature 8° C. Turbidity still high. On the bottom at 140 feet - temperature 7.8° C. We are now on the bottom. The ripple marks appear to be approximately a foot long, about 30 centimeters; height, maybe 3 or 4 centimeters. There is a fair amount of mottling. The ripple marks are well rounded on top. There is definitely a floccy layer of loose material. The troughs are filled mostly with fragments of spiscula. One live crab in the trough, one small asterias. A lot of arrow worms in the water and the density of plankton in the water or seston is, I would say, medium to moderately concentrated. Visibility with the submarine lights is about 3 meters. There's a small hake coming into view. I'm going to attempt to take a few pictures.

This first photo will have two hake in it with a starfish in the foreground. Ripple marks are just about 30 centimeters in wave length. Our heading at the present time is about 180°. The ripple marks trend then at about 210°. Second photo - same area, same shot. I'm going to try to shoot forward. Here's a hake in the forward port. The hake is approximately 6 inches long. Forward port photo #3 to catch the floccy layer, which is variable. The color of the sediment is grey to brown. The texture is medium but coarser material is present in the ripple troughs. There is fairly abundant bioturbation everywhere. The ripple marks ahead of us are not clear, but out to the starboard side are very pronounced. This is a closeup shot now of the material. The floccy layer seems to be broken up to some extent. Next photo - a small scallop, forward at about 3 feet. We are now commencing a traverse approximately across the ripple marks. Now switching camera settings. I have been using 1/60th at F8; I am switching settings to 1/60th

at F5.6. The floccy layer really looks very broken up. There are a lot of discrete pieces. I'll take some shots in the trough. Really looks very good.

We have now moved no more than 25 feet from the first site. We are now heading about 290 - at right angles to the axis of the ripple marks. The floccy layer is quite thin and spotty. Thick in the troughs, thin on the ripple crests. White sand dollars and Ensis shells are common. Some dark colored, very, very small shells - circular, I don't know their name. Here's a hake in the foreground - I'll get a shot of him. Both those photographs had a hake sitting out in the open. There's a red starfish - maybe henricia. The other picture had a hake - mostly buried; and the hake was probably mostly hidden by the floccy layer. The floccy layer now is quite dark brown. I am observing through the lower port - getting a lot of detail. Ripple marks are still spaced beautifully and evenly at about 30 to 40 centimeters - it seems to be getting a little longer now. Abundant dead scallop shells. A lot of Ensis shells and sand dollars. - there's an artica. The only fish I see are hake. There's a large scallop. Abundant white shells in the troughs. We are settling down now. We've moved in on a track of about 290°. We are definitely running on right angles to these ripples. I think the best orientation is about 300° - keeping to my original estimate. I'll get a long-range shot of this. . . There's a crab in the foreground. It is probably about 2 inches across. The ripple marks are quite high - I would say, at least about 5 centimeters. I will get a shot of the ripple marks forward. They're not sharp but still rounded on top. A lot of debris in the troughs. I'm going to try a little television here to get an idea of what these ripple marks look like. . . (conversation regarding settings for camera and communication with Advance II).

TELEVISION TAPE INFORMATION

This is the second dive - Advance II Cruise 75-4. The pilot is Slater and the observer is Folger. We are now at 140 feet - first dive, actually to the bottom. We are now beginning to traverse along, 290°. The ripple crests are finer and strike the we are crossing. There is a moderate amount of bioturbation. We just passed two starfish. (The range here is about right. The zoom I brought all the way to one side - 1.8 on the aperture).

There are good shots right here, as a matter of fact. Let's take two shots while we are sitting on the bottom. There should be a large spiscula and ensis right in the foreground. The spiscula is roughly four inches. We are looking right down a ripple trough. Right along the edge of the ripple trough; it is filled with debris. The ridge crest over to the left - now approximately in the center of the screen - is somewhat bioturbed. You can see the other trough over to the left of it. There are virtually no large shell fragments up on the crest. It is pitted - very small pits, roughly a centimeter across. . . .

We are now looking out a trough with two starfish in it. . . I can't quite tell what I'm looking at. . . there seems to be two small starfish in the trough with some white shell debris. . . The magnitude of the ripples, the breadth and height of the ripple marks are rather evident here. We see a large crest in the ripple, just to the left or beyond the white ensis shell in the foreground. .

Here is a small hake in the foreground - swimming across in the trough of the ripple. He is approximately 4 inches across and is probably lost now from the field of view. You can see the mottled surface layer. (It almost looks so rimmed it may well be due to bioturbation. There is a whole cluster of sea stars together. We are passing almost at right angles to the ripple marks - or small sand waves, if you want. This one we just passed. . . . We now

have two crabs, another large starfish, another starfish. Abundant shell debris in the troughs of these sand waves. It's a good picture now of their amplitude. The wave length doesn't seem to fluctuate too much; and the orientation so far seems to be about right (they are about the same). Still right around 300°. We are continuing to traverse now. It's exactly 1600 hrs. on the 17th of August. Several scallop shells - abundant scallops, abundant shell debris. We are going to terminate the T.V. phase of the operation now. And with that large field of shell fragments and a ripple - bye, bye heavily bioturbed area.

We are going to take another photograph. There is a superb conglomeration of pebbles, and gravel. We are on 290°, the time is now 1604. This is a spectacular junkyard of very coarse material - very coarse and even pebbles. There is an old, obviously fossilitized scallop shell in the foreground, and a spiscula, even larger, in the foreground. The spiscula is roughly 3 inches, (6 or 7 centimeters). . . There are some spectacular ripple marks up forward here. They are gorgeous! Very sharp. We are shooting now along an enormous amount of debris here. Grevelly debris, and these are very steep ripple marks. If these are more recent, then maybe this explains why they are so large. The amount of actual gravel here looks like rock fragments, plus, of course, a lot of debris. It's just marvelous! Much consists of real pebbles. Those are not shell fragments; let's try to scoop some of this stuff up.

For scale - We are going to take a shot of a nice big scallop shell in the foreground. I would say that it is roughly 2 and one-half inches across. There are several hermit crabs in the area, too, ensis in the foreground that you might not be able to see. The gravel in here is well rounded; light colored with some lesser dark fragments. This is going to be a good shot of the artica and the abundant gravel. (That is remarkable!) All the gravel is well-rounded therefore, reworked. Here's a more long-distance shot out through this gravel patch with the sinuous ripple marks, some bioturbation, several hake coming

into view. Hake in the foreground is about 7 inches long. There is a giant scallop shell over there. (I'd better start compensating for the magnification. Down here, how much difference do you get by looking through this port. (Slater - about 1/4 exaggerated). Well, the sizes I've been giving are 1/4 exaggerated. One more shot out here. Then we are going to start some sampling. Try it. O.K., that's very good. I didn't see anything that coarse last year, Rick. I just wonder if that hurricane didn't stir things up around here. We're stirring stuff up now.

We've now proceeded along the course of roughly 290° for maybe 100 feet or so, or maybe a little more, and at right angles to the ripple marks. This shows the sandy nature of the substrate. There seems to be very little fine material being stirred up by the arm. The scallop shell in the claw has stirred down a distance of several centimeters and there isn't really a great deal of suspended matter being stirred up. We are in an area of very coarse sediment. Gravel is abundant in the ripple troughs - along with shell debris; and here on the ripple crests, it's mainly a medium to coarse sand. We are now going to stop and try to get some samples of this material. There seems to be a thin brown layer on everything. Most of the material that is being suspended appears to be that surficial floccy brown layer. There doesn't seem to be much coming from down deep. The floccy layer does still exist here, and it seems to be a little patchier than it was a year ago.

Our heading is now 280°. Bottom flow is very, very sluggish. It's hardly moving at all. That motion that we can see seems to be by-and-large our own motion. There's an arrow worm. We are taking some T.V. out our upper port. I'm not getting any picture myself, but the actual photos may be different - a fair appreciation of how close and abundant that debris is.

I'm going to try some sampling. I've got jug #5. This first sampler #5, I'm going to take in a trough (I'm going to try to take it in a trough).

END OF SIDE ONE OF TAPE

O.K., we're back on the other side of the tape now. We're still trying to collect one sample. Submarine has walked away from the sample. The hake are all coming in because we've stirred up the bottom and I am going to paddle our way over.

#5 is closed. Quite an abundance of life around where we are digging. Here comes an enormous hermit crab. That was really in the debris area in a TROUGH. . . (getting fix on position). The current motion here is almost zero. If anything, it's moving -- it's crossing our path from right to left; very, very sluggish. So it looks like we are actually being moved by an oscillatory motion. In fact, that seems to be what we've actually got here. You can see the plankton moving back and forth, at less than 1 centimeter or so - if it's moving at all. It's oscillatory motion goes roughly at a north/south direction. Although it is very hard to tell because we are being moved by the same flow that's moving the plankton. . . .

Rick, you see that hake over there that just came off that big mound? Let's get a sample there on the top of that. . .

We are now going to try for a ripple crest. . . I think I can get on the top of one these ridge crests. It's a mottled one, but the sediment texture is pretty homogeneous (hey, get out of there, those hake are sure fiesty). I'm going to try to bring it in close and get this big one right in this big pile right next to us.

This jug that we have to use will have some contamination in it. If I can, I'll tip it up. Depth, 144 feet.

#2 sampling container, I'm going to see if I can get some gravel. There are some shells with thick algae growths on them. There's a big piece of shale lying here. This is really a good trough.

Sample #3 - I wonder what that pale coralline material is - that real branchy stuff. Look how deep that ripple mark is. Maybe I'd better get a shot. Whew! those are pretty darn high. I bet those are new. We started at

1530 and it's now 1700. We've been down an hour and a half.

O.K., we are getting ready to surface. The time is 1755. I will take one final photograph. You can see how large some of these ripples are. Beginning our ascent at exactly 1655. Clearing the bottom and heading on up. Fair amount of floccy material right here, before we've lifted away.

We are at a depth of 130' - temperature 9.2 centigrade. 120 feet - depth-temperature 9°. Depth 100 feet - temperature still 9°. We have adjusted the thermometer. Temperature is still 9°, 90 feet. 80 feet - temperature is about 9°. 70 feet - temperature is still 9°. 60 feet - temperature is still 9°. 50 feet - temperature is 10°. 40 feet clearing, temperature 15°, thermocline. 30 feet - temperature now 18° rising. 20 feet - 21°. Visibility is worst right there in the thermocline. We are now at the surface - temperature 23° centigrade. Very heavy turbidity. At the surface at 1700. Very heavy turbidity through the thermocline. A lot of material there. The dive is concluded at 1700.

END OF TAPE

This is 18 August 75, at 1617, commencing the fourth dive of Nekton Beta for the day. Dive 443.

We are now commencing descent at 1618.. At 40' and descending. Turbidity is high. We are now at 60 feet. The turbidity is increasing. Crossing 90 feet. It is quite dark; the depth is now 135 feet. Lights are now on. Abundant seston. On the bottom at 1620. The depth is 150 feet.

We are now sitting on the bottom. (We are almost lying parallel to the ripple marks). We don't have any slave gyro; the magnetic compass says that we are lying in a heading of SE and we are lying roughly parallel to some fairly abrupt ripple marks. These are rounded, 30 - 40 centimeters high. Quite high. The bottom - even the crests of these ripple marks - is covered with a grey floccy material. Appears to be broken up and patchy. The troughs are filled with fine gravel. Most of the sand appears to be medium to coarse grained. The debris ranges from very large artica shells to a lot of fine fragments of those shells and small artica shells, small sand dollars and some others I can't identify. There are a number of very small red shrimp and small red starfish are common. I am going to try to sample with the new device to get some hydrocarbon samples.

We are now going to try to sample on the bottom. We are right in the middle of a wave crest. I have bottle #2 - this is a small polycarbonate tube and I can dig it in very well and have buried it in relatively soft sediment. I have now filled the tube up fairly well. We are on a crest. There is a good bit of white shelled debris in it. Now comes the question of how to close it off, without losing it all.

We've got a pretty good sampling here of the floccy layer on top. This big hake has got his nose right in this whole business. He's lying right in around my sampler. Very interested in the proceedings. He must be feeding. It must be just like Thanksgiving. . .

The ripple crests are very unconsolidated. Maybe that comes from bioturbation. . . No. 2 is on a crest and is full of sediment; and we will try to bring it up just as it is.

We now collected sample #1. We got a fairly good trough sample - adjacent to the one #2 is in; I'm going to try to do #3 right on the next ridge over. I'm not really too satisfied with the amount of stuff I got in #1 though. I'm going to go dig in the trough a minute more. Coarse stuff jams in the tube - precisely why cores aren't usually very good in that coarse stuff.

O.K., now I'm going for #3. . . I'm going to try to dig in on the adjacent ridge - if you can wind them up out of range of the bottom, then that will be O.K. Otherwise, we are just going to drag them along and contaminate them. Do you think you can wind them up high enough?

#3 has been taken right on the adjacent crest. So then we have the #2 on the ridge crest; #1 is in the intermediate trough, and #3 is on the next crest. We dug in fairly well.

We're going to shoot the three bottles with the television. You can just see the claw in the foreground. The samples have been taken from adjacent crest, trough, and crest. You can see the large hake investigating the activities. Apparently, we have stirred up a considerable amount of food. The topography in the area has double, broad ripples.

(Bringing up samples to secure on sub)

#3 was slightly contaminated with some crest stuff, but it isn't bad.

I'm going to start to get some pictures here from that lower port. There's some magnificent views of those ripples, if I can get them on both black and white and color it would be very nice.

On this first picture of this dive, I'm going to try to get a low angle shot of the ripple marks. (Boy, those are beauts. I've got the claw right in the foreground). This is an attempt to get the magnitude of these ripples in

a low angle shot. That photo has a scoured area in the foreground. I'll take another one. . . We're set for f16 and 60th. I'll bracket it all over the place. Now we'll switch down to f11/60th. This is going to be a hell of a good picture if we get it. This is the best picture of ripples I've ever seen. We've got a mountain out here, if it will show; (let's play with the focus a little). That's the nice thing about F11, F16; we should have all kinds of depths of focus. (Slater - there seems to be a beer bottle over here). Folger - We better have a look at it. That would be good to take a look at, because we could see how much sedimentation there has been. Where is it?. . . (going towards bottle). We've got everything in the world down here, so I had better take black and white and color.

I'm looking right down the trough now. There is a crab in the foreground and a live scallop, white colored, in the foreground. Good picture of it. That's going to be good. There is a fair amount of current. Now I'd better take a color picture. . . (conversation about crab s and scallop shells). I would say the current today is moving almost at right angles to the ripple mark crests. . . The port is about 7 inches across. About 6 seconds to get by the port, (3 cm/sec). We are now going to run a little bit to get a compass heading. There goes a large scallop. We're running exactly perpendicular to the strike of the ripples and we're running into the current. There is definitely a current flowing and it is also at right angles to the ripple crest. Now there are many shells here that are both concave side up and down. Both scallop shells and artica. Predominantly they are up, but there are quite a number that are not. We just switched off all the lights and we are just cruising along under ambient light. Quite a bit of light here. There's a very large scallop in the trough. It's cleaned out an enormous area. There's a hake, another hake. Troughs now are very steep, almost 6 - 8 inches high and their wave length is

definitely about 2 feet, somewhere in the vicinity of 60 centimeters. There is a lot of mottling. Here comes a scallop running right at us. Quite a bit of floccy layered stuff. The live scallops seem to be quite small. Our heading during that traverse was 200, true. So the ripple marks then are oriented to 290; so that's just what we had yesterday. So there's a fairly consistent pattern of ridge axis running at 290, or very near it; and the very slow drift seems to be definitely at right angles to those today.

We are now going to run perpendicular to the ripple marks. They lie about 290 - 300. You can see the bands of white shells very clearly. Ripple marks here are probably 40 - 60 centimeters in wave length. Wave heights are quite high. We are now just settling down. Floc is quite thick here.

The current is still drifting, but looks even slower. How high would you say those ripples are? (Slater - 6 inches). Some might be as much as 8. I don't see much asymetry on these. They look pretty symmetrical, pretty well rounded. But I feel pretty sure that these are much higher than those we saw last night.

O.K., I'm going to traverse again, perpendicular to the ripple marks. (Slater - scallops make quite a depression, don't they? There's a big school of squid down there). I'd like to get some shots of the squid. I think if I can get a low angle shot right here of that big live scallop, see those blue eyes, just gorgeous.

(Slater - How does this area differ from last year?) Folger - I think the ripple marks are a good bit higher. I think there is so much life that I don't think they will last long. It sure is active. I want to get a good picture of this scallop. He is about 5 feet out. I'm going to shoot this other one right here in the foreground, mainly to show the stuff right here in the shell. That's got very coarse sand in it. I think I can pick that up pretty well.

When you look at it, you say "how did that stuff get in there"? There's a little tiny red shrimp. A hake. A scallop jumping beside it knocked some stuff into his shell. A crab burroughing away. This is a beautiful shot of the floccy stuff here.

Some of the very floccy material is on the crest. Now it is interesting that the floccy stuff seems to be thickest on the north side of the crest.

(Slater - This floccy stuff makes big stripes (diagonal) right across these ripples. You know what that might be. That might have something to do with the current's stream. The way it is layed down. If a lot of it comes from the sewage, maybe its because the stuff gets streamed out.

END OF SIDE ONE OF TAPE

You know you get stripes of material on the surface of the water. Those. . . If there is enough circulation above the thermocline, the sewage and so on, you get concentrated streamers. Then it settles and might be represented down here. . .

Did I get a black and white of this floc? Let me just make sure I got one of those. I'm looking right smack at a little hake here. . . (Slater - look out to the left there. . . you see those stripes, big, broad. Every time we turn the lights out and we stop and look, we see that stuff. Folger - I bet this stuff is getting laid down here by some other phenomenon.

Slater - The first time I noticed it was with Don, a couple dives ago. I got him up here and showed it to him, too. It's not as obvious here as it is in other places, but you can still see it. The floc is much thicker on the north side. . .

Folger - We're heading south. . . we're heading 175°

Slater - The ripples were steep on the north side. . .

Folger - The one I was just looking at - the south side was heavier. . .

Slater - The south side was heavier, and the steep side of the ripples were on the north side that one place we saw.

Folger - That's what I was saying. From up here I can't tell which side is thicker; out here it looks like the south side. Over here, it still looks like the south side. . . That's reasonable. That would suggest that the prevailing current direction is from the north and that the stuff is getting winnowed off the top and dumped in the lee. There's some enormous shells down here on the crest. Well, all that white stuff is probably pretty old, but some shells in here don't look so old - big ones, you know. But they are all down in the trough. Few are up on the crests, and that means they are getting knocked off those crests by something.

Folger - Well, any kind of little current would knock them down there, but I think animals probably. Just when we sit here, look at the hake running around and the scallops taking off. Multiply that by hundreds and hundreds of times.

Folger - There's a lot of light, isn't there. . .really amazing.

Slater - not much color.

Folger - No. I imagine nothing like it is down in the tropics.

Slater - Well, you don't see any color, not with ambient light down there either. Just at this depth you lose everything. This isn't the most interesting bottom.

Beginning to surface at 1724. Depth is 150' and we are beginning to go up. The turbidity increases in the thermocline here. We are off the bottom and rising slowly. Depth is 140', temperature is 8.2° C. Plankton at this depth, not very abundant, quite fine. 130', temperature 8.0° - visibility is excellent. We can still see stripes down there. We are now at a depth of 125'. We can still see the bottom from here. It's remarkable. 120', the temperature is about 8.1° - ascending. We are now at 110, the temperature 8.0°. Lot of salps. But mostly it's very fine material. 80 feet, temperature is 8.0°. 70 feet, temperature is now still 8.0°. The ambient light is now increasing. Lot of salps - very fine particulate matter still here. 60 feet, temperature beginning to increase - 8.5°. 45 feet, much turbidity, very fine in nature; we are now up to 12°. 30 feet - we are now at 15°. 20 feet - we are now at 19°. Coming close to the surface. 10 feet - temperature 23°. On the surface - temperature 25°. On the surface 1727. Completion of dive.

END OF TAPE

This is dive #448. Time is 1553. Diving in the center of the Dupont Acid Dump Site. Commencing descent at 1555. Surface water temperature is 26° Centigrade. We are now passing through 10 feet - visibility is moderate. Passing through 20 feet, approaching 30 feet. Temperature still about 25.8°C. Very dark here at 50 feet. Temperature is 24.2°. Depth 70 feet - temperature 16°. Depth 90 feet - temperature 12.5°. Very heavy turbidity. . .visibility is low. Depth 110 feet; temperature 10°C. Turbidity still high. Depth 120' temperature 10°. Depth 130 feet - temperature 10° holding. Depth, 140 ft - on the bottom. Temperature holding nicely at 10°. Now cooling off a little to 9.5°. Well, she's now settled back again at 10°.

We're now heading 350°. Traverse to clear the ship. Bottom looks quite flat. No obvious small ripple marks. There's one large quahaug shell, concave side down. Abundant white shell debris. There's another quahaug shell, concave side down. One concave side up. Many down, however. Sort of a mottled texture - mainly going under ambient light for a distance here. Good bit of white shell debris. Very fine white shell debris. Some complete shells, but a lot that are now broken down.

Floccy layers here alright. There appears to be a fair amount of silt. Color is grey to brownish grey. Looks like a little juvenile crab. There's a lot of fine material in this sediment. The floccy material here at the bottom is somewhat stringy; no color to it. The bottom certainly does not have any reddish cast.

Alright, we're on a heading now of 175°. There is a coating of gray material all over the bottom here. This looks more like the sewage site from last time than it does the Dupont Site. Visibility is very good down here. Everything is coated with this brownish-grey layer. There is a fair amount of bioturbation, but it doesn't look new. It looks like everything has got this coating on it. Quite a number of shells standing up from the bottom. Many of the white shells are coated with the floccy layer, many of the concave-up shells are filled with it. There

is a big scallop shell that is not filled - it looks old. Now we are getting into a shell debris field. . . both concave up and down shells. Many small mounds - maybe 3 or 4 centimeters across. Small organisms - stock organisms. Some big clappers that are wide open.

Now there is a reddish texture developing. . . a reddish cast to the sediment. As we get a little above it, you can see that the ripple is tinged - reddish purple. A few mounds. Many juvenile crabs, all running along the bottom. Small flounder. No evidence of any ripple trend. We have just gone over a big mound or sandwave. We still on 175? Slater - more like 180. . . . Look at this! Here's a big box or something right here.

We've moved from an area with a moderate number of shells into what looks like a graveyard. These are mostly spiscula, artica, and many, many scallops, predominantly concave side up.

A lot of fine debris being stirred up by the submersible. So there is a lot of it around. A good question is - Why is so much fine particulate matter here, when we haven't seen it elsewhere? I think I will get a picture here, as soon as it clears up a little. There's more current now than there was. What's your heading now (Slater - just about 190).

We're in the trough and there are very big waves. Particulate matter is drifting. . . (that's pretty fast, you know). The current looks faster than anything we've seen. It's coming across from left to right. . . It definitely moves away from us here in eddies. So it looks like we're headed about 180, the current seems to be headed northwest, and it looks pretty fast. It's several centimeters per second. That's interesting. That's the first time we have seen the current go in that direction, and it's moving rapidly.

Our heading is 210°, and we're now looking right down the trough. This first picture of this set (let's try black and white), we will be trying to catch the abundance of the debris and the amount of fine particulate matter. . . We'll try two different settings of a concave up shell. Some of those shells are absolutely orange. There's one down here that's just orange. . . You see that big

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Folger

starfish with two arms on that great big artica. See him trying to open it. Man, I've got everything in the world, cardboard box, hake, a starfish, a hermit crab. What more could you ask for? This is great, you know. We've really got a lot of stuff right here. I want to try to catch this color. Because we haven't seen anything like it, really. This picture is going to have an orange spiscula shell right in the foreground. . . Now if I can hold that live guy with the starfish on him, I'll try to pull him over. I want to dig into this stuff anyway. Got the starfish, and lost the clam. Got them both in the bag. Now let's see; what's that thing out there. Oh, that's a hake all curled up - a very light color. What we really need is some T.V. coverage coming on to this field.

We'll run along here through this swale and in and out of it to show the contrast. There is a pavement of very fine textured ground-up stuff underneath this thick layer. . . .

We are now on the crest of one of the ripples, (I'm not getting any picture).

We are now taking T.V. on one of these crests. This is dive 448, 19 August 75, Nekton Beta. We are now looking at an enormous shell debris field which is in a trough. Apparently, it is a long wave length, ridge and swale topography area. We are now coming up on another crest; we are now descending again, very slowly. . .

Our heading now is about 180. Here we are, a run from the crest to the same trough. . . and then we move again, to the other side.

We are now in the shell area again. Some longer range shots to compare the depth. . . 141. . . Notice the turbidity that's been stirred up by the submersible. This is very fine textured material that veneers all of this. Shortly we are going to have to dig into it and see what it looks like down below. In fact, we might as well try that right now, while we are here. . . Here we go. I'll now start digging.

Notice the clouds of debris coming up. Below the surface is fine-textured material, predominantly sand. Some silt, maybe even clay are present; and it does

stay up in the water a little while. So the short duration suggests it's made mostly of silt. See how thick the shells are. The predominant material is definitely a fine to medium grained sand and it certainly has a component of finer stuff in it.

So, we are in here at 141 feet on the bottom of the swale. We'll try it up on a crest now (see if we can get a wave length on this now, Rick). Some more orange shells. A lot of debris. There's a green bottle. Can you recover it and see if there is stuff in it? (maneuvering to get the bottle). So, we've got 141 feet and we're going to try for a crest. Enormous shell field - I'm going to get a picture of that. This crest is not winnowed at all. Look at that damn stuff, that gravelly material is all over. Depth is 140 to 141 feet. Very pointed hummocks in here. . . Very big swale running along over there.

SIDE 2

Dive 448. Right in the middle of the trough, abundant shells. Fair number of crabs. There are some fairly large crabs in here and a lot of mounds, which I assume are crabs. I can only describe them as looking very mamillary. I'm going to try for a close picture of a tiny shrimp. This is a little red shrimp in here. What's interesting about this is the very fine texture and flatness of the bottom. Excellent. . . He's right next to the shell debris field. I shall now try to shoot a little longer range. Note of big orange artica shell here in the foreground. I would say he is probably 4 inches long. There's another big scallop shell, concave side up-to identify this photo.

I'm going to try another closer, if you'll sway back the other way. We may just drift over there; we're moving that way. A lot of little red shrimp on the bottom. There's a perfect little anemone, next to the shrimp over there. I'd really like to get it, but I don't know if we will. Here we go. . . Beautiful. . . there's a neat little anemone. The scale of that little shrimp is only an inch long at the most, and the little anemone is an inch and one half maybe, at the most. So we are looking at very small creatures. You can see in the area many juvenile crabs.

The color pattern is interesting. It's a light tan, surficial layer, interspersed with dark color, a dark grey, which appears to be sometimes like small worm tubes. In other words, I'm pretty sure this looks like fecal material.

Now we are in close to the bottom. The current is ^{^^}rubbing fairly rapidly here.

There's some kind of snake. Slater - that little white one? Say, you know that currents pretty strong right here on the bottom. It's pulling us right around.

What have we got for a heading now? Slater, 250. Add 90 to that. 340 is the way the current's going. That's what we figured before. That's good. Actually, it's going pretty darn fast. How fast would you say that was? That looks more than 5 centimeters; maybe 10 centimeters. Although I would like to get something quantitative on it. . . (Slater - there's a big anemone). . . I've got a great big crab here.

There's a neat little red crab right below us. These little things that look like sea urchins - spines sticking out of them, but they do not appear to be stiff.

There's a little bone right here. It looks like a fish vertebrae. There's an oyster.

Here's some ripples. That's pretty good. Here we've got an old ripple. an old sand wave and it's about a 2 meter wave length and it lies parallel to these great big ones. We're about to go into the trough up here . . . Our heading must be about 210° or reciprocal. Is it? (Slater - 210) So, tonight we want to run the side scan sonar at right angles to 210. About 300. Here's a piece of wood. (Slater - there's a big barrel). It's a huge junkyard. It's an enormous graveyard. That's a big shell, (click). I'm going to get several of those and try different exposures. . . I'll try a black and white. He's bound to turn around in a minute, (5.6 at 1/60). . . That's what it is, an old paint can. Boy, that's a big hake. I'm looking at him right in the nose. We're coming right over him and he doesn't like it one bit. We're on top of his can and he is going to be very angry. . . . I think we've squeezed it. We've got a lot of pictures of all this junk on the bottom. There's a nice shot; I only hope these come out. These are really something. Look at all the hake. . . more than I saw last year. What's interesting is

that there is very little of the red material that we saw last year. Very fine sand - greyish green. Lot of shrimp. This is so good. . .you begin to feel how limestones develop. This would be a sandy, limey stringer in an otherwise relatively clean sand. We've got a magnificent big hermit crab. It looks like the one we saw before - right under me, (click). Let's just keep drifting. See those enormous scallop shells over there. Let's get some of those. . .might be worth collecting. They're funny looking. There's a lot of concave-downs here. Boy, all the crabs are up in fighting stance. Those are pretty. Let's put the bag down and get three or four of those. I like this bag rig you've got. Oh, submarine, don't go away on me. I've got it. They are enormous. The bag is folded up. I've the shell half in. I'll get it.

I think we can say the amplitude on those waves is at least a couple of feet, maybe more.

We are off bottom at 1710. We are going to lift slowly and see what we can do in the thermocline. See if there is any acid waste in it. We are now at 140 and slowly rising. . .I think we've got a fair amount of current. We are drifting to the north. We're moving right along. We're up off the bottom now and moving smartly. Passing through 100, some of these salps just showing up now. A lot of them. It's beginning to clear somewhat. Ambient light's going up. I see no evidence of any acid waste so far. At 80 feet ambient light increasing. Still no evidence of any acid waste so far. At 70 feet - ascending. No, it's only at about 25 or 30 feet. Here's some concentrated stuff, a little more concentrated stuff. This doesn't look like acid waste. This just looks like normal flocs. On the surface at 1713, completed dive.

END OF TAPE #3

This is Nekton Beta Dive #454 at 1620, 20 August 1975. Commencing descent at 1622. Surface water temperature is 27°. We are now at 10 feet - temperature 26.5° C. Descending to 20 feet - temperature 26.5°; 30 feet - still 26.5°; 40 feet - 26.5°; 50 feet - 26.4°; 60 feet - 26.2°; 70 feet - 24°; 80 feet - 21.5°; 90 feet - 19.8°; 100 feet - 17.5°; declining rapidly. 130 feet - 11.5°; 140 feet - 10.0°; 160 feet - 8.5°. On the bottom at 170 feet, temperature 8.2°.

We are sitting on the bottom under ambient light conditions. Looks quite flat with abundant white shell hash. There is a lot of white shell hash overlain by concave up shells. Quite a few oyster shells right out here - so presumably, we're in some lagoonal situation at one time. A lot of quahaugs. Considerable amount of material filling the quahaugs. A good number of sea clams, as well. There's some more very large oysters. Seems to be two phases here: one, the white shell hash - very abundant; probably most of it less than 2 or 3 centimeters across overlain by abundant whole, concave-up quahaug shells. A lot are still fastened or hinged. There are also quite a number of ensis shells in the bottom.

The distribution - an estimate of the big clapper shells appears to be, 20 per square meter, to 5 per square meter. I don't get any real impression of ripple marks here at all; it's really quite free of them. We are now going into somewhat sparsely covered area. Now here we are going into a large. . . well, now here's a very nice swale. We're now driving into it. We were on some kind of ridge-like form. We've now moved down into an area of much more concentrated quahaug shells, and shell hash. This doesn't appear to be quite as densely concentrated as at the last station. It seems to be a little more spread out. We are now on a little (patch) of less debris. I don't know how this is going to look on the side scan sonar. It's probably going to be a

more of a background noisy return - no trend is obvious. Very subdued topography.

This is sort of a little hollow. Must be $2/3$ of a meter deep or so. The bottom is a dark brown with a lot of, looks like, algae stuff or organic material sticking up. The submarine has stirred up considerable amount of floccy material that we're now in; the surface is very unstable. . . must be very fine material. . . almost muddy. Most of the shells have got some material on them that appears to be some kind of plant or animal growth. What do you think those little tubes are? Are those worm tubes, or what? See all those tiny, little tubes sticking out of the ground. See, there's a field of them. The small tubes look to be about 2 centimeters long at most, maybe less; a millimeter across. All stick up vertically, sort of looks like a brush hair-cut. It seems to cover everything, and the color is dark brown. In the hummocks, the sediment itself also appears to be a dark brown. I'll take a shot of that - I think that might be worthwhile. This picture is to show the fine material. This has got, in the foreground, about midway on the left, two quahaug shells. One must be 3 inches long, the other about $3\frac{1}{2}$. You may see in the foreground $1/4$ of a red clam. I'll just shoot for the midpoint of this field of tubes. That's good. I think that will show. That's a good picture. (Slater - you want a sample here?) Yeah, maybe we'll just grab one here.

We're right in this little depression. Most of this stuff is just shell hash. I'm looking for evidence of acid leeching on some of the shells. They certainly look pretty brittle, but I can't say whether acid is responsible for that. Let's see if we can get a sample, and include some of these tubes. I think tonight with the Smith-Mac sample, I might hit some of that stuff we have here. I got a lot of good surface stuff there. That's really a good catch. Stick it in there. That is nice. That'll be a hard sample to analyze for texture with all that stuff.

Bottle #1 is now closed and full of sediment from this little hummock. It should include a considerable volume of surficial material that covers the bottom;

many, many tubes. That will be a good representative sample of the upper two or three centimeters - more than that, upper 4 centimeters, probably. There's one of those ribbon fish over there again.

Now there seems to be some trend over there. You can see to the far right there is a little channel. These little snakes or eel are all over the place. Lots of the shells are covered with reddish material. Most of the bottom is covered by these little tubes. We'll have to ask the biologists what these tubes are. The bottom is absolutely covered by them. More oysters. A real junkyard out there again. Tremendous amount of debris. Most of the shells in this are are concave up. There are two concave down. The view is really fantastic. How far do you think we can see? (Slater - 40 or 50 feet easy, I would say). 15 or 20 meters visibility here. Hey, see this dark lane here. Several darkish patches that stand right out. There is quite a little relief here. Quite a bit of relief. Big starfish. Dark area appears to be mainly those tubes. This is nice. We just came up on something, Rick. This is an amazing field of material. It doesn't look very actively winnowed because there is so much of the white stuff sitting in the shells. Certainly it's silty; some fine to medium grained sand, with a lot of silty material in it - at least at the surficial layer. . . possibly mainly organic in origin.

I'm going to stir up some mud with the arm, just to see what the current looks like. We probably ought to set to get the direction of the current. Say, that's pretty fast right on the bottom down there. I'm going to try to get an estimate. . . There's a little sea pen down here that's just being pushed over by the current very nicely. The current doesn't seem to bother these little red shrimp at all. There's a lot of them. Little tiny things. We are pretty much floating along with the current ourselves, aren't we?

Hey, there's a fantastic sea slug down here. He's just cruising along. Isn't that neat! I've never seen one in action. He's just covering everything

in sight. He just looks like a big snail. . .I mean a snail without any outside. He's beautiful. Just oozing along to beat the band. Maybe on this heading, I can get a current speed. That's pretty strong. Let's see. How fast do you think it is going here? (counting here). . .I'm getting about 3 seconds across the port. Hey, there's another one of these snails. I could never get a good photograph of him though. He's right on top of me though, I'll take one anyway. (click). He's right on top of a neat little starfish.

In that shot, there's a broken quahaug shell that's about 4 inches in length. There's also another little quahaug open with sand in the middle of it. It's actually a pretty good picture. The current is active, right on the bottom here. It's actively winnowing some fine materials. As a matter of fact, most of the little tubes on the bottom are in motion; and small particles of light floccy material are being picked up and wafted along. And that's right smack on the bottom. The time across the port is about 2 1/2 seconds. So, the current is moving right along here. The picture also has a nice starfish on the broken quahaug, and it has some kind of a nudibranch. He looks like a snail. There's a little nudibranch or snail-like thing crawling right along beside a little red starfish. (Slater - they can swim). Sea slug, that's what it is. There's quite a few right in here. There's our first live scallop.

I'm going to dig a hole there. I want to see what's down below. The current's moving fast enough to carry this debris out of the way. See what those tubes are and how deep they go. Bob mentioned a dark colored layer. There's this clayey layer. . .very stiff clay. There's a lot of fine stuff in here. . . Well, now, I've dug a big hole. All the hake are moving in to get in on the goodies. Those hake move pretty fast. See, the whole bottom is littered with these things. There's a live scallop. According to the biologists, they said they hadn't seen anything live.

The bottom sediment is very, very loose. I've been down the full depth of

of the jaws. That bottom current is moving stuff away very quickly. I think we should take some television right here to document the current.

O.K., this is dive #454, Nekton Beta. We are east of the Dupont Acid site. Abundant fine material here, and a lot of very fine tubes, that cover the bottom. The bottom is also littered with white shell hash, and many open quahaug and sea clam shells. . .generally, concave side upward. In this photograph you can see the hake start moving around the depression that we just dug with the claw. I'm going to try to stir some of that material up, to give some idea of the currents (I will try to hold the camera steady). There's a fairly strong set to the current here. Watch the material flow by. You can see the water clear quite quickly. The sediment is mainly fine to medium sand. It has a fair component of finer textured stuff in it. I guess it might be mainly organic. I can see it drift away to the left. We will establish a heading on the sub shortly and we can get a direction of that flow. Yesterday, it was primarily from the north, or towards the north, rather. You can see the hake moving. . .

Watch that hake kicking up those tubes, and watch them move along now. There's actually a little bit of scour on the bottom at this current velocity. See that hake picking that material up and see it flow away rather quickly. So the combination of bioturbation and current motion is nicely documented here. The hake stirs up the material and the current then winnows it away. This is the strongest current we've seen. Let me try a few more measurements. We're in a good spot. We're sort of lying with it. (counting) It's a lot faster than anything I've seen. See that hake over there, bargain along the bottom - the area we were digging in. Whenever we dig, the hake appear immediately, in order to take advantage of the food that's stirred up in the substrata. It's rather interesting in this area. I wonder if the shell pavement is responsible in part for the lack of ripple development. In effect, you've got a winnowing process as

the current increases you get this fine stuff winnowed away and then you would be left with a more and more concentrated pavement of shell debris; it effectively, probably neutralizes any tendency to ripples. Well, certainly, the current that's going right now isn't adequate to turn anything over. These two hake are having the biggest time eating. They are both just chomping things up to beat the band. You've got a better biological shot of how hake feed than any geology in here. Geology seems to be pretty well wrapped up in this conglomerate pavement of shells. Let's tour around while I've got the T.V. here. I'll try to get some out of the upper window. They're a little better up there if we have enough light. . . .

I can hardly see a thing up here now. I could before. I can see from the lower port, but not up here.

We are now on a traverse. I'm going to take a few shots as we go here. We did see one live scallop, that flew away. We might run into a few more. Switching onto a lower port. You can see the nature of the fine textured bottom. . .

Now there's some pretty good active starfish. That big one there must eat everything. . .there's a hake hiding. Boy, this is featureless. Now the shell hash is sort of spread out. Back into it. Great patches of it. Some of those clappers look very fresh. Very white. I still don't see any trend. It just looks like a heterogeneous random distribution of shell hash. Big crab right there. Current ought to move us right back by him.

(Advance II calling) Let's see if he can give us a heading. . . . There's another live scallop. There's a hake. Boy, we're flying. . .We are in an enormous concentrated shell hash area now. There's a crab feeding. . . .

SIDE 2

We're traversing around to try and get that rock and see what it is. Stirred up a fair amount of debris in the area. It's hard to see now. . . Just below those tubes you can see a fine, olive-gray sand. I've got it.

It is a rock, I think; or a shell. I don't think a shell would stay there that long. Maybe it's a bone. The current is just picking up the sub and whirling us around. It looks like a big mussel. Let's just cruise along a minute or two more and I'll take more pictures.

Now, we're just traversing. Switching now to the lower port. . . Look at these two big crabs here. Ah, there's two fierce, fiesty, fighting crabs. That's a good picture. Right over on top of them. They're going to be upset, to say the least. . . There's another great big mussel. A lot of crabs. . . . That's beautiful. Ought to get some coverage of this long range stuff. That's really nice. . . I think these will be pretty good shots. . . . There's a big empty clapper. . . Scallops - there's just a few around. 5:30, time for supper. Hey, there goes a swimming nudibranch. Look at him go. He isn't swimming, just floating.

I think we've dug down far enough to see how deep this fine stuff goes. I don't think there's a whole lot more we can do. There's no trend that I can see down here. I'll get two shots here on the bottom. This gives you a pretty good idea of the magnitude of the current. . . appears to be quite rapid. Got some good pictures of the plankton flowing by. There is a piece of skate's egg about to get blown away. You can see it's unstable.

I'm getting a pretty good angle on it. I'll get a few more measurements across the window here. (1,000, 2,000, 3,000, etc) That's about right. It takes about 3 seconds to get across the frame - at the very most. This plankton is really pretty to watch. Those little arrow worms are gorgeous. There's a lot of stuff moving along the bottom with this current now - mostly organic. Can you see over to my right? There's a couple of big shells sticking up with the hinge up. Right behind them there's kind of a foaming looking thing, sort of purplish.

Try a few more shots on 454. Show the shell hash. I guess the material

in the foreground is some kind of weed that has grown on the mussel. Look at this big hermit crab. I'm waiting for him to do something on T.V. and he may not produce. He's enjoying the scenery now. Come on you rascal - MOVE! Here he comes. He's moving. Here he comes. He's wonderful. What a performance ladies and gentlemen. Could you ask for more?

This is dive #454 concluding. We're departing the bottom here at 1729. I'm still looking out over this extensive field of hash, as we begin our ascent. We are now lying above the bottom at about 6 feet off increasing to about 10 feet. Visibility is excellent down here. The turbidity should be very low when we measure it tonight. 160' and ascending - the bottom is still very clear down below. 155' - the bottom is still clear. We are looking at it in ambient light. I can still see the bottom nicely. 140' - I still have the bottom very nicely, so we've got at least 28 feet of visibility. I can still see it - beginning to lose it at 135'. Losing it now - 132. 130' - it's gone; and we are into these long stringy, beautiful salps. Those things are long. Oh, look at them. They must be 3 feet long. This is the thickest I've ever seen them. Passing through 100' - in the salp zone. Magnificent. Some of them are probably 2' long. 70' - still lots of these long salps. Ascending. Light is increasing. We are passing through 50 feet. No green there. So, apparently, the acid dump hasn't gotten here. 40 feet - the plankton's very abundant. Ascending. On the surface at 1732. Dive #454 concluded.

END OF TAPE #4

This is Nekton Beta Dive #459, on 21 August 1975. We have just launched at 1105. We are now heading in a northeasterly direction to arrive in the northwest side of the sector around the buoy. Commencing descent. Temperature on the surface is 25.8°. 10 feet - 25.8°. 30 feet - 25.8°. 40 feet - 25.8°. Getting into a turbid zone. 50 feet - 24.8°. Temperature declining rapidly. 60 feet - 17.5°. 65 feet - 16.4°. 80 feet - 17.4°. 90 feet - 16.1°. Turbidity increasing. 100 feet - 14.8°. 110 feet - 13.8°. 120 feet - 12.8°. 130 feet - 11.1°. Bottom in sight. 140 feet - 10.8°. We're down. On the bottom at 1111. We will make a traverse along the bottom first.

We've definitely got small ripple marks out there, at wave length of about 60 centimeters. Wave height is about 5 centimeters. Rounded crests. Relatively abrupt and narrow trough between them. Our heading is 045° and we are at about right angle to the ripple marks. Out the port window, it's about the same. . .the ripple mark orientation is about 135°.

Heading 090° - ripple marks here are oriented north/south. That's a new orientation. Turbidity is quite heavy in the water on the bottom. The ripple troughs are filled with white shell hash. The texture of the bottom is medium sand, gray-green. The ripple marks anastomose all over the trough and crest. Ripple mark orientation varies, crustal orientation fluctuates and varies.

Very sinuous wave-crest pattern. There's a hake. Heading still 090°. There's a mottled coloration on the bottom, - a hummocky bottom. . .brownish to greyish in the ambient light. But the crest is a darker brown - boy, there's a ray. Lots of big sand dollars. Many small stars - many of them white. . . Few large clappers, large shells that are not fastened together, concave side up. They're both pecten. Beautiful, big pecten shells, and some big artica. Even the coarsest debris lies in the ripple troughs. There's a few starfish. Here comes some little animal - looks like a jellyfish. We are now in a very flat area. Not much rippling at all. Now we are moving into rippling again.

There's a growth on the bottom here. There is a floccy brown material which probably accounts for the general color variation. It doesn't seem to have any preferred orientation that I can see yet - although there seems to be some striping. Rick, do you see any striping to that darker colored material? (Slater - No, just kind of mottled). It seems to come across the crests. . .

These ripple marks can give you a pattern of a hummock - an elongated hummock - maybe 10 meters long, and an amplitude. . . some of these must go almost up to a foot. They're pretty sharp crests, and they ought to show nicely on the sonar. Quite high. But they do have a tortuous pattern to them. . . in and out of the actual ripple forms. I wouldn't say it's braided. But it's sort of that appearance. Another large sand dollar. Most of the coarse debris is still down in the troughs. . . those ripples are high; must be 20 centimeters high, I should think. Maybe it's 30 centimeters. Oh, there's a jellyfish. . . a monster. Looks like a large scallop there. . . an enormous scallop.

We are now sort of going into a depression. This is a very intensely burrowed area. There's a live scallop right next to us. Very high ripples. Dark brown material goes right over the crests. . . The brown stuff streaks across the ripples at 060°. The ripples still trend about north/south. We're now on a big broad plain again with a large shell debris area. This is an odd bottom here. There's a lot of dark material. There's a huge crab. A lot of small organisms. (Slater - There's a hake buried there, see him?) Yeah, right next to the wood. Lots of hake. There's a big hake sitting right below in a real deep burrow. There's a big flounder. That's a good sized one, isn't it? Live scallops again. Here comes one! Oh, I should get a picture; look at him going along beside us. . . Look at that enormous sand dollar.

I like this range. You must be able to see 15 meters here; even though the turbidity is high, visibility is excellent. The ambient light is just fine. We're headed southeast now. Very strong ripple mark pattern oblique to us.

We're running southeast. . .so north/south trend still holds. Sand dollars, crabs common. Heading southeast, paralleling the brown material. Some beautiful sinuous ridge crests here. (Slater). They're intersecting lineations. We're flying along about a meter above the bottom.

The floccy material in some areas is pretty thick. All marked with tracks and trails. Scallops around here are enormous. Again, this is a very deeply rippled pattern. It's too bad we won't be able to see this in side scan. . .It would be an interesting pattern. It certainly would give a different texture to the sonar. . .The shell debris in the troughs doesn't look abundant enough to get a return. I would think that the ripple shadows behind the ripples themselves would be adequate to give the pattern. The shell hash is generally too sparse and too small to give much of an acoustic return.

There's a hake lying in the sand just down below us. We can pick up some shells and put them in the bag, if we don't see any of that hard stuff. Any idea what the current direction is up there? This hake is watching us. . . Looks like the current's just right from behind us. . .(counting to get velocity) So, it takes about 6 seconds to get across the port. The current velocities here are very low. I'm going to dig in the bottom a little.

This looks a lot sandier. Maybe, medium to coarse is a good description. I don't see much gravel around. There's not much fine material in this either. Not kicking up much at all when we stirred it. Settles right back down. So there isn't very much fine stuff in this area. So, it was either winnowed very clean, or there's not a whole lot of stuff; there is a lot more fine material in the troughs. . . The hake seem to be able to find us the instant we stir anything up. Here they come. They must be able to hear us. . .This would probably be a pretty good picture here to show the ripple marks. It also shows the absence of fossil hash. Last year I don't think I had any good pictures of those ripple marks. I'll take some black and white's here too. There's a scallop

with a great growth right on him right next to us.

Our heading is 210. (Identifying photo). The scallop in the foreground looks like a couple of inches across. You can just see the opening (click). I'll take two photos. . . We'll try some others for the ripple marks too, I think. Two shots there. . . show as 25 and 26 on this roll. Now switch to black and white.

Let's see if we can change our orientation so that black and white may show the contrast better, in the ripples. This is a pretty good orientation here. . . We'll try 6 feet.

This is a TRI X black and white. Again, same shot as we took before with the scallop in the foreground. . . . I'll shoot one back to the right here. There's a large spiscula - looks about 4 or 5 inches across, in the right lower corner of this photo. Let's change our orientation a little. That's nice right there. Here's abundant sand dollars. Millions of them. This looks more like it. There were a lot of those last year. The sand dollars were all lying under the surface. They're all reddish. . .

These are good ripple marks. I think they will show up pretty well. I'll take one more of these. (click). They're hard to highlight.

I might as well shoot a little T.V. . . . This is dive 459 - Nekton Beta. We are in an area about 25 km northeast of the Dupont site. The bottom is medium to coarse grained sand and rather heavily ripple-marked. Ripples have an amplitude of roughly 15 to even 30 centimeters in some areas. Orientation is roughly north/south, and the wave length is probably about 60 centimeters, maybe a little longer. Why don't we cruise a little bit.

You can see some of the ripple marks. . . You can clearly see the ripples and the hummocks here. The white shells in the trough. This is really a heavily trailed and tracked surface. No doubt about that. There are many sand dollars sitting in it, too. Sand dollars just under the sand. Oh, a beautiful big conque shell. . . let's put him in the bag. Hey, look at the fish here inside.

Here's a nice big conque. There's a hake living right inside it. Now we are going to get hold of him maybe. I am going to try to do television in one hand and pick him up in the other. Here we go. O.K., where's the bag? That's a big shell. That little hake's going to stay in there until he can't get out. He's hiding. He's headed the wrong way. That's what you can call blind trust in your house. He's got his head in the sand.

There are some magnificent ripple marks out here. I'm going to have a little shot of those through the television. . . beautiful. . . turbidity is high right here. I'm going to try and get the biologists on our leg to assess the concentration of these organisms. . . look at the size of these things, these are mountains. . . Reddish sand dollar, . . little lobster, little crab, live scallops. . . nice big hake. . . Look at these ripple marks-mighty steep.

See those tracks, those pointy tracks - lobster or maybe crab. (Moving along), very different pattern of ripple marks, and some new orientation and some pretty high ones. You can see a very definite change from the really debris laden areas that we saw before. That is, the tremendous number of shells.

That looked like a lobster claw down there. Here's a lot of big shells. Let's put some of those shells in the bag. . . . (trying to get scallop)

Coming up at 1159. Beginning our ascent. Lift off. 130 feet - bottom is still visible. . . 100 feet - salps. Turbidity very high at 70 feet. Turbidity increasing. 45 feet, about 15 meters; that's right on top of the thermocline. Surface 1202. End of dive 459.

END OF TAPE

This is dive #462, Nekton Beta. 1552, 21 August 1975. We have just launched and cleared the ship. The objective of the dive is to go down and look at a clayey area that apparently has become a good habitat for various organisms. Nekton Beta commencing descent at 1556. . . .

Depth is 0 feet - temperature 26.0°. Depth 40 feet - turbid zone - 26°; 60 feet - 21.0°; definitely in a turbid zone. 80 feet - 19.0°; 100 feet - 13.0°, and declining rapidly; 140 feet - 12.0°. Bottom coming up. On bottom at 148 ft. Time - 1558.

Visibility is terrible. Bottom here is medium sand. Much shell hash spread all over the place. Turning to a heading of 090° to get to the area where the clayey material is abundant. Small flounder. A lot of white shell debris. A large fiddler crab, the biggest one I've ever seen. . . he's enormous. There's a little skate right next to us. Featureless bottom here. No ripple marks. Some bioturbation - not even too much of that. Many, many small white starfish - look dead. Most shells are concave up. A lot of varied shell material on the bottom, I'm looking for clay. I don't see any of it. Not even a whole lot of life here. Those white starfish are alive. A number of clappers open.

This is about the most barren bottom we have seen.

O.K., now we're back in the ripply stuff. (traversing) Here we go, there's the clay. (Slater - See the chunks of clay still on the bottom)? Yeh, we're loaded with them. That's got to be an outcrop. Getting more abundant. Very interesting. Large ripple marks here. Are we heading about east/west? (Slater - we are heading 090 right now). Alright. Good. There's ripple marks. A very sinuous trend, but generally north/south. Here's some big stuff here. Getting more and more abundant. Much debris in those troughs.

Look at that enormous snail shell over there. That's the biggest thing I've ever seen. (Slater - here's that red rock we were talking about). That looks great! I've got to break some of that off. Look at this. Here's a fish that I've

never seen either. Looks like a sea bass. I'll get some pictures of it.

That's just what it is. . .a little sea bass.

The first picture that starts this series has a little sea bass in it, lying against this reddish clayey material. We'll break it off. There's nice, grey, clay in here which may be what's inside. If this stuff is all orange or just simply an organic coating, we'll see. There's a good chunk right in front of me, which I am now going to photograph. The hake in the foreground ought to show up well, too. We'll get a little longer range shot over this way. There is a white shell in the foreground. The scale - that little sea bass, from his dorsal fin down to his pectoral fin is about 2 inches. There is a little red crab down below it too.

That orange coating looks like some sort of organic stuff. . .(breaking off a chunk). Got it! It's iron. It's an oxidized ferruginous clay. It's got a ferruginous coating. I think I got a picture of it.

That slide shows the same view we looked at before with the material broken off, so that you get a nice view of the parent clay. From here it looks like a green-grey clay with clay balls in it. . .There's a big hole in it. It really looks like some of the ironstone - the high concentrated clay stones - that you find exposed along the south side of Martha's Vineyard. It really looks from here like a Tertiary clay. I'm going to break some more off. . .currents moving pretty fast. (Trying to get bag and sample). . .

There's quite a little current. The eel just bit that bass right in the shnoz. First piece in the bag. Second piece in the bag. . .I've got to stop and look at that eel some more. He is enormous. Now I'm going to go for more of this stuff that really looks like parent material. That may take a little wrestling. . . That fish is out there saying, "those crazy geologists, why don't they bug off"? I've got enough of that.

It doesn't want to break. It looks like a well-cemented sandstone. Here comes your lobster. He wants to know what all the noise is about. He's sitting

right under the tail of that great big eel. We may have to root him right out of there and put him in our bag. . .

TELEVISION

Dive #462, Nekton Beta, 21 August 1975. On the bottom - 25 kilometers northeast of the Dupont Acid dumpsite. An apparent outcrop of ironstone or claystone with a heavy ferruginous coating. We've been breaking some of this material off, and it looks like a crust in front of the sample bag which you can see in the foreground. You can see some of the parent material and it sort of looks like a conglomeratic claystone, with clay balls or clay pebbles in it. This is obviously an excellent habitat for organisms, and if you look carefully over to the right below the claw, which I'll move, you can see a rather enormous eel. And just beyond is a lobster, who's sitting underneath this ledge of material. Although, at the present time his claws, which are all that have been showing so far, are not visible. Yes, they are. Just the tip of one claw.

O.K., You can just see that lobster beginning to come out. You can see his claws. He lives right underneath the ledge. He's coming out farther. Directly in line with the claw (points of our own claw), you can see the lobster's claw. He doesn't look too big. He's obviously taking a squint at our claws to see if they look potent. He's really quite small. There is a big rounded pebble in front. There's something else down there. . looks pretty rounded. . .

(Sub traversing) There's quite a lot of that grey clay that seems to be around. It's going to be very interesting. We are moving over to see if we can get another site. . Hey, there's a wonderful big piece of the clay right here. See it? See that little eel. I'm going to take another picture right here. This is outstanding. Is this what Jerry got into. . . It's neat. . buroughed all over the place. . Here's a big hole. Bet there's something in there. . there's a lobster. . what a habitat. Look at all the clay.

This certainly looks like an outcrop. They're all buroughing right into it. It must be a really easy thing to dig in. It's awful soft. I might dig down a

little here in this stuff. . .there's a million little red shrimp, all having a good time. Here's a little skate right here. . .O.K. Right on a great patch right here. This is beautiful. Digging in. I think we might have an outcrop here of Tertiary clay or Pleistocene clay. . .Beautiful big piece. . .looks like good blue clay. Here comes the bag. Blue clay - how about that. Maybe we can get some bugs out of this.

It's a rocky blue clay. There ought to be some mineralization along the fractures in it. Stirring this up brings up a wealth of fine particulate matter. It really does look like clay. It really looks fine. (Taking pictures). That will give us some idea of what the clay layer looks like.

Got another picture and this picture has a red block of clay covered with organic material in the foreground, plus the carapace of a crab in the foreground. The crab is about 2 inches long. . .(taking more pictures) I bet we never get any of it in the dredge, unless we really luck out. . .there's a little hermit crab down there. He's outgrown his shell. He's enormous, and he's all squeezed in there. There's more of the iron stuff there to the right. . .what a big oyster shell. . .high ripple marks in here.

Nekton Beta, dive #462, leaving bottom at 1650. Now ascending. 1652 we are on the surface. Dive #462 completed.

END OF TAPE